DEPARTMENT OF AGRICULTURE.

MISCELLANEOUS. SPECIAL REPORT No. 5.

THE PROPER VALUE AND MANAGEMENT

OF

GOVERNMENT TIMBER LANDS

AND THE

DISTRIBUTION OF NORTH AMERICAN FOREST TREES,

BEING

PAPERS READ AT THE UNITED STATES DEPARTMENT OF AGRICULTURE, MAY 7-8, 1884.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1884.

16093 TIM

CONTENTS.

VALUE AND MANAGEMENT OF GOVERNMENT TIMBER LANDS AND DISTRIBUTION OF NORTH AMERICAN FOREST TREES.

THE VALUE OF AMERICAN TIMBER LANDS.

By Franklin B. Hough, *Lowville, New York*

This question lies at the foundation of the whole subject of American Forestry, and must largely influence the action of the owners of land, whatever they may do, in the preservation or planting of woodlands. The term "unimproved," which we apply to forest land, has come down to us from the pioneer as a synonym for "unproductive" or "unprofitable," and we sometimes hear of land being cleared because the owner "cannot afford to lay out of the use of it any longer."

We will attempt to point out the fallacy of these notions, and to show that an estate vested in woodlands, is neither unproductive nor unprofitable; but that on the contrary it is productive in revenue, reasonably safe as an investment, beyond the reach of speculative changes in value, and certain in its returns.

It may be remarked in the beginning, that since no lands have been hitherto reserved by our general or State governments for the maintenance and future supply of timber, and as the titles have passed to private owners, throughout the whole of the settled portions of the country—neither of these forms of government can have anything to do with the management of these lands. So far as foreign forest codes have reference to the management of woodlands upon the public domain, or upon estates owned by local communities or to public institutions, we can derive no aid from them, nor have we an interest in the jurisprudence that has arisen in the administration of these rights. From the simple and absolute tenure of our titles, we shall be for the most part wholly free from all the vexations and perplexities that elsewhere arise between landlord and tenant, or in the enjoyment of rights of common usage.

In some of the States, as in New York, certain tracts of wild land, once private property, have reverted to the State by failure of their owners to pay taxes. It is probable that these lands are very poor, and that the most of the timber has been cut off. Their reversion necessitates some plan of care and management, and questions of water supply and climatic influences are coming in with the arguments they afford in favor of legislative action in their behalf. But under these circum-

stances the question of present value or of future profits scarcely comes into the account, and will not be further considered on this occasion. The subject before us is, the ownership of woodlands by individuals, and the profits or losses that may affect their value, or operate as motives for their maintenance or their clearing.

It may be stated as a rule without exception, that the individual will govern his action as to woodlands as he does as to his fields, in the manner that will best serve his personal interest, and wholly without regard to any theories as to the effect it may have upon the public welfare.

It is further found, as the experience of the world, and it is especially true in our own country where the laws are made by those who are governed by them, that public control will not be tolerated in the management of private property, unless a public interest is to be protected thereby, and the reason of interference is just and evident.

We have before us another fact which is of the highest importance in this connection. We are at present wholly without any provision on the part of Government for the maintenance of woodlands upon the public domain, and as this domain is fast passing to private owners, there is not even a remote probability that any considerable part of the timber for the supply of our wants will ever be grown upon our public lands. If to this we add the fact that no foreign country has a surplus to supply us, we are led to the conclusion that whatever timber the future may require must be supplied from private lands.

It may require a crisis of want and high prices, the result of improvidence, to convince our people of the value of growing timber, but whenever such a time does come, the lesson will be learned and remembered, and our people will begin to see value in a growing tree.

We should seek to avoid the inconvenience and distress which scarcity and high prices would unavoidably occasion; and I regard the tendency of our "Arbor days," and school festivals in the interest of planting as in the highest degree beneficial—not so much for what is actually done, as for the effect it may have upon our young people, the scholars now in our schools, who will in a few years become the owners of our lands. It need not be said, for it is evident, that the planting and protection of groves and woodlands will not be undertaken by those who have spent a part of their lives in clearing land, nor by those who have acquired the notion that land has no productive value until it has been cleared.

The planting and care of woodlands leads to an appreciation and enjoyment of sylvan scenery, and every measure tending to the cultivation of rural tastes, is conducive to this end. We must first counteract the habit of destruction and waste which was acquired by the pioneer, or that has been handed down from him, before a beginning can be made. This is the first task in popular education before us, and it is eminently proper that it should begin in our schools.

As the land-owner will be governed by his own particular interest, with little regard for the general welfare, or the profit of others, he must be convinced that there is something to be gained by him in an enterprise before he will undertake it. As the returns of forestry are more or less remote, it will require a certain degree of foresight, of intelligence, and of faith in the future, in order to enable him to realize the prospects of the enterprise, and the extent and certainty of his returns.

In new industries where experience is wanting and experiment is necessary before success is assured it has been found good policy on the part of Government to encourage undertaking by bounties, premiums, exemptions from taxation, and other inducements for a limited time, and until the experience needed for successful operation had been acquired. It is by these means, and the further aid to be derived from experiment stations, scientific researches, and the diffusion of knowledge upon the subject, that the State governments may render the most substantial assistance in the advancement of Forestry.

As for bounties and premiums, their offer implies some competent and impartial agency for deciding between rival applicants. In the State of New York, in former years, the Judges of the County Courts, the Society for the Promotion of the Useful Arts, a Board of Agriculture, and the State and County Agricultural Societies have upon several occasions been empowered to examine and decide upon questions of this nature. There can be no question but that in the absence of State Forestry Associations the general or local Agricultural and Horticultural Societies throughout the country would be the best agencies for awarding these distinctions.

From the fixed and immovable nature of forest property, nothing could be done in the way of exhibition to the general public, excepting in the way of excursions, as is done by the Scottish Arboricultural and other Societies, but a great deal of benefit could be derived from the reports of visiting committees, statistical returns, and plain practical essays by competent and experienced observers and special agents. The best of these essays and reports should be rewarded by suitable prizes, and they should be widely distributed among those who would be most benefited by them.

In whatever manner these bounties or prizes might be offered, or any exemption from taxation in aid of planting might be allowed, it would not be good policy to make them unlimited as to time. A business that needs perpetual relief or support is a poor one, and if it cannot stand alone after fair assistance in the beginning it presents no inducement to enterprise; it will invite no investment of capital, and may as well be abandoned altogether.

In the recent discussions upon the forest question in New York, some have suggested the suspension of all taxes upon all existing woodlands as an inducement for their preservation. In my opinion this would be unwise and unjust; in fact, that it would not tend to the end proposed,

nor would it encourage planting. On the other hand, an exemption for a limited period, say from ten to twenty years, upon denuded lands when planted would tend directly to encouragement, and might itself, in many cases, present an inducement where nothing would have been done without it. In some States, as in Nebraska, where the constitution forbids the exemption of any kind of property from taxation, the Legislature has gone to the extent of its power in declaring lands thus planted as not liable to any increased valuation by reason of planting. This general or partial exemption from taxation for a limited time I regard as eminently proper; but beyond this it would afford just reason of complaint from the owners of property in other forms, and if enacted it would not long be endured.

In the Prairie States, where the want of wood was among the first to be felt, the settlers needed no arguments to enforce the motives for planting, and in these States we now find by far the greatest number of young plantations, and the most intelligence in their management. The facility with which lumber has been brought in by the railroads has relieved these sections of the country from an experience that would have been trying without them, and has doubtless limited forest-tree planting to a point far below what may hereafter be found a proper amount; but the beginning made is good, and the fault is only in its not going far enough. It admits of extension as the want becomes felt, and will doubtless be expanded hereafter as the demand and prices justify until it meets at least the local requirements.

In some instances the substitution of coal for fuel, and of iron for buildings, bridges, and naval architecture, has undoubtedly reduced very largely the consumption of wood and timber in the country. But it may be doubted as to whether these substitutions for wood have in reality tended to prolong our forest supplies. On the contrary, it has, by reducing the current prices, withdrawn the motives for longer maintenance, and upon many farms throughout the country the reserved wood lots have been cleared off as no longer needed for the family's use. Still these changes in the use of materials for fuel and construction are most fortunate, and they may be extended a great deal further with the greatest benefit. In Europe it has long ago been learned that not only the walls but the roofs and floors of buildings can be made of cheaper and better materials than wood; that wooden fences can be almost wholly dispensed with; that pavements and platforms of stone or brick are more economical and durable than those of plank, and that even iron railway ties and telegraph poles, although expensive at first, have advantages that, upon the whole, give them preference for use.

But however far these economies in the use of substitutes for wood may be carried, the demand is steadily increasing as a material for manufactures, and every year is adding the number of uses to which wood may be applied, and for which nothing else can be substituted.

The preparation of wood-pulp for paper; the distillation of acetates for chemical purposes; the multiplication of tanneries, and the increase of establishments for the making of railway cars, wagons, joinery, furniture, agricultural implements, and the innumerable other articles for which nothing but wood can be used, present a vast and growing demand upon our woodlands, which is steadily and surely reducing their area and exhausting their supplies.

At present prices, and upon highly fertile and arable lands, the grasses, grains, and fruits yield without doubt a more profitable return than could be realized from timber growth. But there are considerable tracts of land too broken and stony for cultivation that are in fact good for nothing else, but on which timber trees may be grown as well as if the surface were entirely smooth and free of stones. There are hillsides too steep for prudent pasturage, barren hill-tops that need forest protection, and ravines and river banks now suffering from erosions, that might be filled with woodland growth, without sensibly reducing the area that may be profitably employed in agriculture, and at very small expense.

In many parts of the country we find fields exhausted by improvident tillage, and often thrown out and abandoned as waste, that might be occupied by woodlands and restored in fertility by the annual decay of leaves. The exhaustion does not generally extend deep, and the subsoil will be found amply sufficient for the growth of forest trees. In places like these timber culture will pay, even at present prices, a moderately fair percentage, and almost without cost. In every case, however, it is profitable to give attention to a tract that is coming up as a spontaneous second growth. Poor and worthless species may be suppressed, and the more valuable kinds favored; a dense growth may be thinned out, and vacant places may be filled in without much expense, and with great profit in the end.

It need not be denied that large forest estates cannot be managed so as to produce large timber without an investment of capital, and that they cannot be held excepting by those who can afford to wait for the returns. Some of the great state forests in Europe are worked in periods of a hundred years and more, and the plans of management, the periods of thinnings, and time of final cutting are decided upon in the beginning, and are carried out without change to the end. The returns, although long delayed, are very large, and the interest upon the investment, above all expenses, is a reasonably fair one. The yield is several times greater than that of a common wildwood, with all its chances of injury from accident and neglect. If anything of this kind is ever seen in our country, it will probably be in the hands of some stock company or corporation, which, having acquired large tracts of broken land at a low price, may adopt the most approved methods for conducting their business, and may be able, as the market prices of timber may hereafter range, to divide a reasonably large surplus over all expenses.

It would be a great and positive gain if we could convince the owners of land (and it is unquestionably true and capable of proof) that planted lands, under ordinary conditions, have an additional value from the beginning, and that this value is increasing every year at a gaining rate. If the owner wishes to sell at any time, the land and the growth upon it will always command a price equal to the first value, added to value gained by growth. In many cases already the native timber upon wild land will sell for as much as the average farming land of the vicinity, leaving the land itself still in possession of the former owner. With proper protection from cattle and from fires, this same land in from thirty to fifty years, will have regained a similar growth, with whatever advantage there may be gained from advanced prices.

There are incidental advantages from the cultivation of groves and wood-lands interspersed among arable fields, and it might be shown that the farm crops afford a greater and more certain yield from the presence of woodlands between them. But with the present state of intelligence upon these subjects among the general class of our landholders, it is not probable that these considerations would have weight, unless entirely in accord with their own ideas of present or immediate advantage, nor can we ever expect any concerted and general action among them founded upon ideas of a public benefit.

The planting done hereafter upon private lands, must be visibly for the owner's advantage, and nothing else. It will not be done by a tenant, unless he is hired and paid for it; nor by the man of limited means, unless having special skill, he can find profit in selling his young plantations and undertaking others.

Under the present depressed condition of agricultural affairs in Great Britain, a suggestion has been made that the planting of forest trees might bring a better return than farm crops, as well as a benefit to the country. If this is true upon land where the raising of farm crops is possible, how much more so it must be upon lands now unimproved, but still suitable for tree-planting.

According to the last census, over 11 per cent. of the land included in farms is reported as unimproved—neither cultivated, pastured, nor in woodland, but waste. That this condition should exist in the prairie States and Territories, still but partly settled, need not surprise us; but 7 per cent. in Massachusetts, 6 per cent. in Connecticut, 3 per cent. in New York and Pennsylvania, about 3 per cent. in New Jersey, and so on of the older States, is too much; for in these States there are no tracts of dry land upon which trees of some kind cannot be grown.

As we cannot compel by law the private owner to plant, we must persuade him by pointing out the advantages to be derived from it—if not in returns that he can touch in his life-time—with certainty in an increased value in his property, whether sold or left as an inheritance to his family. The land-owner must be convinced that where he expends money or labor in planting he is putting these values at interest,

and that they will come back to him at certain future intervals of time, or at a fixed period, with these accrued values, or that their worth may be realized should he wish to sell. It is a work of popular education, through the various agencies by which public opinion is created or influenced, and upon these we must depend for whatever result may be obtained.

THE VALUE AND MANAGEMENT OF GOVERNMENT TIMBER LANDS.

By N. H. Egleston, *Chief of the Forestry Division of the Agricultural Department.*

The value of Government timber lands, like that of all timber lands, is of two kinds. They have a value for their commercial products, such as lumber, bark, resins, seeds, &c. This value will depend upon the character of the trees growing on the lands, their kind, their abundance, their size, their accessibility, the facilities for obtaining their products, the distance at which they are from a proper market, and the character of the demand for them or their products. These, not to mention other considerations, must enter into any satisfactory estimate of the commercial value of any timber lands. This value of timber lands, therefore, will vary greatly with time and place. Fifty years ago, for instance, the great pine forests of Michigan had, we may say, no commercial value, because they were so remote from population, and, consequently, from market that there was no demand for what has since sold for millions and made thousands rich. Ten years ago the timber lands of Oregon and Washington Territory had little, if any, commercial value, for the same reason. Now, the completion of the Pacific Railroad, and the approximate exhaustion of the forests of Michigan, Wisconsin, and Minnesota have given a greatly increased value to those lands.

So, again, forests, composed of the best kinds of trees, may be growing on mountain sides of such altitude and so difficult of approach that they will not pay any one for converting them either into lumber or fuel. Or they may be growing in inaccessible swamps, and on that account will have no commercial value, and the lands sustaining such forests will have no market price.

But timber lands have another value besides that which is commercial, and this may be a higher one than any which can be measured by dollars and cents. This may be called their climatic and hygienic value, though in many cases it blends intimately with the commercial. The most careful and scientific investigations have shown beyond question that forests have a very perceptible influence in modifying climate. They have much to do with the temperature and moisture of the atmosphere in their vicinity and for a considerable distance from them. They influence the atmospheric currents. If they are not direct producers of rain they affect its distribution. They have much to do with the flow

of streams, and so with all the hygrometric conditions and influences connected with them. They thus become potent factors in determining the character of the climate of any particular region. They have, therefore, an important bearing upon health as well as upon the agricultural, commercial, and manufacturing interests of a country. Instances are not rare in which the removal of forests has been followed by insalubrity of climate and the restoration of the forests has been accompanied by its corresponding improvement. The destruction of the forests in many European and Asiatic countries has greatly lessened the agricultural productiveness of those countries. Lands once teeming with valuable grains and fruits have been made almost deserts by the destruction of the forests which once protected them. Streams which once bore the commerce of nations have ceased to be navigable, in consequence of the removal of the forests which formerly sheltered their head springs, while the navigation of other streams is becoming more and more difficult from year to year as the destruction of the forests, in which their head springs are situated or through which they flow, proceeds.

It is plain, therefore, that while some forests may have little commercial value, and on this account may be worthy of little notice, and may not be reckoned among the items of individual or of national wealth, they may be of the greatest importance in other respects and have a value so great that all the care and power of a nation may properly be called into requisition for their preservation. This climatic or meteorologic value of forests has only recently been recognized to any considerable extent, though individuals—the more thoughtful and observing—have seen it and taken notice of it to some extent from a very early period. But as it has come to be more widely recognized, especially during the last hundred years, and more particularly still during the last fifty, many of the European countries have made the management of the forests one of the most prominent and urgent duties of the government. In Germany and France, especially, this is the case. Laws most particular and imperative are enacted for the purpose of preserving existing forests or planting and maintaining forests where they have formerly been cut off, but where they are needed for climatic or other reasons affecting the public health or welfare. The individual landholder is not permitted to sweep away his forest trees at his pleasure, as he is with us, but, on the principle "*salus populi suprema lex*," he can only cut the trees so far and so fast as the authorities having this matter in charge pronounce to be consistent with the general interest, and then, usually, it is only on condition that a young tree shall be planted wherever an old one is cut. The forests belonging to the Government are managed in the same way, and while they are thus made conducive to the general welfare they are also made the source of large revenues. The budgets show that in the year 1883 Prussian Germany expended $8,128,625 in the care and management of her public forests, and received from the same, from the sale of lumber and

other products and the privilege of hunting and fishing, $13,092,875, or a net revenue of $4,964,250, while France during the same time expended 14,405,032 francs and received 35,768,900 francs, or a net profit of 21,363,868 francs, or $4,272,773 in round numbers.

Now, as to the value of our Government timber lands, to the consideration of which this paper is restricted, only an approximate estimate can be formed, for the reason that we know comparatively little about the timber lands belonging to the Government. Strange to say the Government has taken hardly any account of its timber lands. In the disposal of its lands the Government has gone upon the presumption that they would be used for agricultural purposes. In surveying them for the purpose of selling them, and so defining their boundaries that a satisfactory description and location of them could be given to the purchaser, they have been plotted by simple right lines, running north and south, east and west. The character of the land has been taken into account very little. To some extent the field notes of the surveyors give information as to swamps and wooded lands, but only a special examination by the contemplating purchaser could enable him to decide as to the real value of any piece of land. The vast amount of forests on the public domain, worth more than all its lands if cleared of timber, worth more than all the minerals within the ground, capable of yielding, in connection with private forests, products annually of greater commercial value than the largest cereal crop or that of cotton, the Government has taken no notice of. It has not regarded them as adding one dollar to its assets. It has put no higher price upon a section of land having timber on it worth thousands of dollars than it has upon a section of the poorest open land, destitute of tree or shrub, swept by the blizzards of the north or the siroccos from the Gulf and favored with so little rainfall as to forbid any profitable cultivation.

The only recognition of value in timber was in the early years of the present century, when the superior quality of the live-oak for shipbuilding induced some legislation on the part of Congress for the preservation of the limited amount of that timber growing in some of the Southern States, in order to provide a sufficient supply for the construction of our naval vessels.

In recent years, as great depredations have been made upon the public timber lands in other parts of the country, some efforts have been made to restrain them. But this has been done only to a partial extent, and by certain rulings and constructions by which the acts referring to the appropriation of the live-oak timber have been made applicable to other timber rather than by any express legislation designed to meet the case. The Government cannot be said to have taken any such action as would indicate that it regards its timber as valuable property, to be guarded and protected as property should be.

If it is asked, then, what is the value of the Government timber lands, the answer must be, we cannot tell, because the Government has not

even taken a proper inventory of its lands. It does not know how much timber land it possesses, nor what is its quality. We can estimate its value only approximately. In reply to an inquiry on the subject, the Commissioner of the Land Office says, "There is more or less timber in all the States and Territories containing public lands, but since such lands are not classified as to timber, the proportion of the same in each cannot be arrived at by this office."

Without, therefore, venturing upon any figures to represent the commercial value of the timber lands, inasmuch as we know so little as to the quantity of such lands or the quality of the timber growing upon them, we can only say, and this we can say with all confidence, that the estimated 84,000,000 acres of timber land still belonging to the Government must have a large commercial value. Some of it may be so situated as to have but little appreciable value now. But with the progressive settlement of the country and the increasing demands for lumber the value of such lands will be increasing rapidly. In Michigan and Wisconsin and in other States railroads are built for the very purpose of getting access to timber and bringing it to market. So a tract of timber which to-day has little if any appreciable value, may in twelve months, by the advent of a railway, be made more valuable than a mine of silver or gold. The commercial value of timber lands belonging to the Government is greater than that of similar lands belonging to private persons. The Government is under no necessity of disposing of its property within a particular limit of time as the individual owner usually is. It can wait for the fullest development of the value of its timber by the growth of centuries if need be. But this fact makes the more imperative the duty of the Government to protect such property both from injury and destruction.

As to the marketable value of the Government timber lands, while a portion of such lands, on account of present inaccessibility or distance from settlements or important commercial points, may have but little value, much of those lands are saleable, and would be in greater demand than they are were it not for the fact that forest fires render such property hazardous and that unscrupulous persons find it cheaper to steal timber than to buy it. The very fact also of the plundering of the Government timber lands proves, wherever it occurs, that the timber on such lands has a present market value. Men do not steal what has no value. Even the slight care which the Government has extended to its forests has resulted in the discovery that they have been plundered to the extent of several millions of dollars' worth of timber.

But apart from their pecuniary or commercial value, timber lands have a value which may be even greater, certainly more indispensable, than that. As modifiers and safeguards of climate, and thus having a bearing upon the health and comfort of the people and the productiveness of the agriculturists' fields; as distributors of rain-fall and regulators of streams, and thus having a bearing upon both commerce and

manufactures, they have a combined value which no figures can represent, but which is not the less, only greater, on that account. Their value in these respects is so great that their loss has been the ruin of nations, and if we are to maintain our prosperity as a nation we must maintain to a proper extent our forests. The tokens of coming trouble from the destruction of our forests are already visible. But the results of our rapid and reckless waste of them are not yet fully apparent. The complete effect of what we have done is not yet felt. Nature moves slowly. As we have been fifty years pursuing a course of conduct which has only in recent times so far developed its legitimate results as to excite our attention and beget alarm, so those results will continue to be developed for years to come, do what we may to remove the causes of them and to restore the former condition of things.

But this slowness with which natural causes work is the strongest argument for prompt and decisive action on our part. It will take years to arrest the evil results of our past action. We ought on this account to begin the work without delay, while past experience should teach us to refrain from repeating in other parts of the country the inconsiderate course of conduct which we have pursued.

As to the management of the Government timber lands, clearly there should be a change from the course hitherto pursued. It would seem to be the plainest dictate of common sense that the Government should recognize the fact that in its timber lands it has a valuable property besides the lands themselves, and that as a wise proprietor it should care for and protect that property and use it for its own highest advantage. Like a wise property-holder, it should first of all take an account of stock, ascertain how much of this forest property it has, and how much it is worth. At present the Government does not know, except in a very indefinite way, where or what its timber lands are. It does not know how dense its forests are, of what kind of trees composed, how situated, how valuable for one use or another. The first thing a private person claiming to own this property would do would be to refuse to sell any of it until he had carefully examined it, and, having thus ascertained its adaptation for various uses, had been able to form an intelligent decision as to its most advantageous disposal. Why should not the United States Government act in a similar way? Why should it not suspend the sale of its timber lands until it can make an accurate survey of them and ascertain their character and situation, and their value for one purpose or another?

Having done this, such of its timber lands as it would be desirable to have preserved in a forest state, for climatic reasons or on account of the favorable influence which they would exert upon the flow of rivers and streams, should continue to be withheld from sale, the timber growing thereon alone being sold, and that only by selection of the full-grown trees from time to time, and not all at once as has been the usage with the forests. The trees should be sold by Government officers, who

should be known as Forest Conservators, and the trees should be felled under their direction and in such a manner as not to injure the young and growing trees, and the place made vacant should be planted at once, so that the forest should be kept well stocked and in a growing, thrifty condition all the while. This is the way the Government forests are managed in Europe, and they are thus made an important source of revenue, while at the same time they are made the safeguards of public health, and promoters of the general welfare in many ways. So well satisfied are the people of the wisdon of this management, so convinced of the great importance to their welfare of an adequate supply of trees that the tendency is continually to increase the area of land devoted permanently to tree-growth instead of diminishing it, notwith standing the increase of population would tend to make inroads upon the forests in order to obtain additional land for tillage purposes. The people have become convinced that the most successful and remunerative tillage cannot be had without the aid and protection which the forests afford, while the trees are their best security against floods and droughts and devastating torrents.

A step in the direction of forest preservation has lately been made by the proposal to the Senate by Senator Edmunds of a bill for an act reserving from sale and protecting from injury a tract of about 7,000 square miles, mostly covered with timber, in the Territory of Montana, and embracing the head waters of the Missouri, the Columbia, and the Saskatchewan rivers. This proposal will meet the unhesitating approval of every member of this forestry congress, and it is to be hoped the equally unhesitating approval of every member of the National Congress. Once committed to the preservation of the Government timber lands for the public good, as it would be by such an enactment, we should be encouraged in the expectation that the Government would adopt other measures of like character, as from time to time they should be seen to be desirable, and that in due time we should become wise husbanders of our national forest treasures, instead of the reckless wasters that we have been.

Having thus ascertained what portion of our timber lands ought to be maintained in the forest condition and taken measures for its preservation as such, the rest might be offered for sale outright as our lands have been in time past, or the timber only might, in this case also, be sold, as it is in Canada, no trees being allowed to be cut that are of less than a certain diameter, and the land itself remaining still the property of the Government.

Such, it seems to me is the value, and such should be the management of the Government timber lands. Such a view of the subject implies a change, as has been seen, in the dealing of the Government in respect to its property in lands. It implies an increased expenditure in watching, protecting, and disposing properly of its timber lands. But there is no property of the Government so valuable as this, and therefore so

well deserving of expenditure for its protection and preservation. There is no property of the Government the care and protection of which will bring so large a return of profit to the State and of benefit to the people. It is estimated that the value of the annual products of our forests is not less than $800,000,000, outmeasuring the value of our great cereal crop, that of corn; more than that of our crops of hay, rye, oats, barley, buckwheat, potatoes, and tobacco taken together, and ten times that of all our mines of gold and silver. Can we be too considerate or too liberal in expenditure for the care and preservation of such interests?

THE VALUE AND MANAGEMENT OF THE TIMBER LANDS OF THE UNITED STATES.

By F. P. Baker.

It will be seen that the topic assigned me at this meeting refers not to the general forest area of the United States, belonging both to public and private parties, but that I am called upon to speak only of the forest lands actually belonging at this time to the National Government.

It would be naturally supposed that there could be nothing easier than to find in official records the answers to two questions embraced in the title of this paper:

1. How many acres of timber are owned by the Government; and
2. What are those acres worth?

Application to that well-informed and courteous gentleman, the Commissioner of the General Land Office, revealed the fact, however, that the Government of the United States does not know how much timber it owns, where it is located, or its actual condition and value. All the figures in the possession of the Interior Department are, at best, meager and approximate. This condition of affairs of itself justifies the existence of the Bureau of Forestry. There have, of course, been, volumes of reports on the subject of forestry in general of the United States, and of suggestions in regard to the preserving of the Government timber, but, as I have said, the report is still unwritten which contains a complete and satisfactory answer to him who would know the extent of those forests which are still under the absolute control of the Government.

The volume issued by the Public Land Commission, and entitled "The Public Domain," estimates that in 1880 the Government still retained 85,000,000 acres of timber valued at $2.50 an acre, which would amount to $212,500,000.

We are so accustomed to speaking of immense areas in connection with the public lands, that a hundred thousand or a million or so acres of land is considered a trifle, and in fact 85,000,000 acres is a small fraction of what was once the public domain, estimated at 1,852,310,987 acres.

Yet 85,000,000 acres of forest comprised in one body would make a very respectable "wood lot," particularly when, at a low estimate, it was considered worth $212,500,000. It is an area half as large as the State of Texas and more than three times as large as the State of Virginia. It may seem strange that any uncertainty should exist in regard to a possession so valuable, but it must be remembered that the Government has parted with a forest domain very much larger and more valuable without any special restraints or regulations conveying an idea of its special value. In disposing of the great forested States east of the Mississippi, forest lands were sold or granted at the same price or on the same conditions as any other lands. The Government never made any difference between forest and prairie, save that millions of acres of forest were disposed of, as if an incumbrance, under the vague title of "swamp lands." This is singular when we consider that the earliest settlers of the Western States set a great, in fact an undue, value on forest lands for purely agricultural purposes. The first value of the prairie was at first imperfectly understood in States like Illinois, and the pioneers clung to the wooded lands along the streams, and condemned themselves to years of hard work in consequence. Had the Government then placed a higher price on the timbered lands, it might have been better for all parties. The prairies would have been settled earlier and the lesson of the true use of forest taught in season.

The past, however, cannot be recalled, and the first question before us is, what is the extent and value of the timbered lands still in possession of the Government? And, growing out of these questions, what, in the light of past experience, should be done with them?

In the absence of official figures, we cannot say just where all these lands are located, or which lands are the most valuable. In our search for them we must be guided by certain generally known facts.

In the first place, it is, of course, understood that what are called arable lands in the older States are occupied, and that the Government lands remaining unsold or undisposed of in these States are broken, mountainous, swampy, or sandy barrens, and such lands are covered with forest growth of greater or less value. So of the 23,000,000 acres of land in the Southern States which the Government owns, the larger part may be supposed to be forest. And as these lands lie, for the most part, in the States of Florida, Alabama, Mississippi, Arkansas, and Louisiana, it will be safe to say that the larger part of these lands are pine lands.

The unsurveyed public lands lie in Minnesota, Nebraska, California, Nevada, Oregon, Washington, Colorado, Utah, Arizona, New Mexico, Dakota, Idaho, Montana, Wyoming, Louisiana, Florida, Indian Territory, and Alaska.

Within this region lies, beside the lands in the Southern States, what is left of the forest domain of the United States Government. The Government in 1880 owned in round numbers 28,000,000 surveyed acres

in Minnesota and 5,000,000 surveyed acres in Wisconsin, but these by this time may be considered as passed or rapidly passing from the control of the Government.

Of the territory containing lands still belonging to the Government, Nebraska and Dakota are prairie regions; Utah and New Mexico are, to say the least, not timbered countries. The Indian Territory is not open to settlement, and with its present inhabitants nobody, outside of it, is concerned about its future. The unsurveyed lands in Florida are in the Everglades and are inaccessible.

The timbered lands of the United States, then, in which the greatest interest should be felt are situated on the east and west slopes of the Rocky Mountains and parallel ranges in California, Nevada, Oregon, Washington, Colorado, Idaho, Montana, and Wyoming, and much the largest proportion in California, Oregon, Washington, and Colorado.

Here we have given in a rude way the location in two great bodies, or regions, of the 85,000,000 acres of forest, more or less, belonging to the United States.

The forest lands belonging to the Government in the Southern States are, and have been for years, for sale at $1.25 an acre, and for two or three years past have been in active demand, especially in Arkansas and Mississippi. An attempt was made some years ago to fix a price on and sell the timber land unfit for cultivation in California, Oregon, Nevada, and the Territory of Wyoming, but, while the price was set at the low figure of $2.50 per acre, in two years only 20,000 acres were disposed of. In a country where Government timber has always been stolen there has not yet sprung up an ardent desire to buy it.

But here is the timber. It grows on the mountain slopes at a height of 11,000 feet. Nearly all of it is fir, spruce, pine, and cedar. It is valuable enough to be foraged upon by miners, railroad-tie cutters, and charcoal burners. But much of it is inaccessible to the woodman, and yet it has a value, and that value is not to be estimated in dollars and cents. What shall be done with it?

If the Government should sell off its Southern pine lands at the estimated value, $2.50 an acre, and put the money in the National Treasury, the bargain might be a fair one. But if the Government should sell off its forests in the Rocky Mountains at $2.50 an acre, the condition, positive or implied, being that the forest should be at once cleared off, the bargain would be the worst ever made in the world.

In these mountains rise the Platte, the Arkansas, the Rio Grande, great rivers, and numberless small ones. On the existence of the forest on the mountain slopes depends the fact whether these streams shall, to use a figure, die or live. The question is one that once interested a few thousand people; it is one that now interests millions. The value of these forests lies not in what they will sell for in the shape of railroad ties or charcoal, but in their being the conservators of climate, the guardians of the snow, the reservoirs of rivers. Once the Rio

Grande and the Arkansas sent their waters through narrow ditches, painfully dug by the Mexican with his mattock and hoe, to water a few acres of alfalfa or of vineyard, but now these rivers are to play their part in mighty agricultural enterprises hundreds of miles from the mountains. There is in the course of construction in Kansas to-day one irrigating ditch 45 feet wide, to be, with its laterals, 200 miles long, and intended to water 500,000 acres, and this enterprise is only one of many such in progress in Kansas and Colorado, saying nothing of the canals already in existence in Colorado, Utah, and New Mexico. No estimate of the value of the forests on the Rocky Mountain slopes can be made without reference to the value of these irrigation enterprises present and to come.

If the Government could sell these forests for money at any figure, no matter how small, the case might assume a different aspect; but experience has shown that no sale can be effected. The only alternative offered the Government is, Shall the forests be stolen or wasted by careless fires, or shall they be preserved to be a priceless blessing? The slopes of the Rocky Mountains up to 11,000 feet of altitude will certainly never be taken up under the homestead or pre-emption acts, or sold for cash. The timber under the present system will suffer as before. It will be cut, stunted, girdled, burned. It will disappear, and the result will be desolation; the frequent land and snow-slides carrying destruction; the drying up of streams great and small; and the utter exhaustion of the supply of timber, now more than sufficient for the ordinary and reasonable uses of the local population.

Thus we have given in a rough way, a reference to rather than an account of, the forest domain of the Government. Now a few words as to its management.

That branch of the Government of the United States having charge of the public lands for the better part of a century and till within a very few years was conducted apparently in utter ignorance of the economic value of forests.

A few thousand acres of live-oak and cedar reserved for the use of the Navy, a general commission to land officers to prevent the unauthorized cutting of timber, if they felt disposed; this was all the Government did until 1877 to save for itself or the people such forests as grew nowhere else on the face of the globe. Since 1877 special agents have been employed to protect the timber, or rather to lock the stable after the horse is stolen, by prosecutions after the timber has disappeared. But a substantial advance has been made by the institution of the Bureau of Forestry, and it is to be hoped that intelligent action will follow the acquisition of knowledge.

The State of New York affords an illustration. The State had a forest domain in the Adirondacks. It suffered that domain to pass out of its hands and beyond its control. The woods were cut down and wasted, and for non-payment of taxes the desolated acres fell back into the hands

of the State. The question now is, "What is the value and extent of the forested and deforested domain of the State of New York." The loss the State has sustained by the altered flow of water in the Hudson and other streams is apparent enough, but the way to a sufficient remedy is full of difficulties. The objection rises at once, that in order to secure a sufficient area to conserve and grow the necessary forest the land of private parties must be purchased and that the State will be forced to pay exorbitant figures.

In the case of the Government this difficulty does not exist. Its ownership and control is absolute. The power exists to withdraw tomorrow every acre of Government timber land from sale or entry. In the case of the Rocky Mountain forests this should be done. If the preservation of the natural curiosities of the Yellowstone Park justifies such a course on a small scale, the preservation of the agriculture of New Mexico, Utah, Colorado, Western Kansas, and Nebraska justifies it on a large scale.

The "extent" of the timber lands of the United States should be maintained in order that their "value" may be increased. The forests should be kept, not given away; preserved, not wasted. The timber can be kept growing where it now stands, and be restored where it has been wasted. No citizen or honest settler or miner will suffer thereby. It is not necessary to his health, happiness, or prosperity that the fire shall leave the side of the mountain bare or that wealthy railroad corporations shall use stolen ties.

It is seen that when we come to speak of the "management" of Government timber lands we enter on a new field. There has been so far nothing that indicates the existence of a plan on the part of the Government having for its object the preservation of the forest still under its ownership and control. Under that head I would make a few suggestions:

1. Timber lands, properly so called, should be subjected to a different classification from arable lands, and the Government should, as soon as possible, cause such lands to be surveyed and described, so that it may be known where the lands are, the character of the timber, and their value.

2. Government timber should nowhere be sold at $1.25 an acre. If sold at all a price should be fixed upon it somewhere near its value.

3. Until the land is sold the timber should be carefully protected from spoliation by fire and timber thieves. This applies to pine lands in the South.

4. In the case of the Rocky Mountain forests the Government should at once withdraw them from sale or entry. Their destruction, authorized or unauthorized, is an evil for which there is no possible compensation.

5. The continued holding of the timber lands by the Government should be so regulated that waste, fallen, and surplus trees may be dis-

posed of for the absolute wants of the settlers; but no more timber should be slashed down, and no more railroad corporations be furnished ties at the expense of the Nation.

6. The care of the Government forests should not be left to the inefficient supervision of land officers whose present duties render such supervision impossible, but should be made the work of trained, competent, and honest men, commissioned by the Federal Government, responsible to and paid by it, and performing the work similar to the Government foresters of other countries.

7 The Department of Forestry, the duties of which are at present merely to collect information and give advice, should be organized into a working force, intrusted with the labor of classifying, describing, and preserving the Government forests, increasing their area, where practicable, by replanting and other means, and by bringing to justice those parties who trespass on the public timber lands, either in wantonness or for the purpose of plunder.

8. In connection with these labors it should be remembered that "knowledge is power," and consequently the training of a body of foresters should go on at Schools of Forestry and experimental stations to be established and maintained in different parts of the Union by the General Government. By these agencies also the whole theory of the effect of forests on climate, on the flow of streams, and other kindred matters should be carefully studied, and the result be made known to the public.

In the little Republic of Switzerland there is law enough and power to prevent the cutting of a single tree where its disappearance might make way for the avalanche. The Government of the most enlightened and powerful country on earth, if we may believe its orators, is certainly strong enough and wise enough to prevent the spoliation and wasting of its own property.

I have given in a very general way my views of the value of a great property belonging to the people of this country, and I indulge in the hope that the Government will continue to collect the facts concerning the great interest in some convenient and accessible form, so that some future investigator may be able to speak to you in a more detailed, accurate, interesting, and instructive manner than I have been able to do.

VALUE AND MANAGEMENT OF GOVERNMENT TIMBER-LANDS.

By B. E. Fernow.

This question involves the determination of the problem as to whether consistently with the maxims of true statesmanship the State or Government *ought* to own and manage any lands except so far as they are absolutely necessary to its existence, or until it can properly dispose of them to settlers.

We agree that, as a rule, the management of all economies is much better performed by private individuals than by the State; in fact, that it is undesirable for the Government to engage in any mercantile business, and therefore we would reject any arguments for the retention of Government forests, solely drawn from financial considerations. Such reasons, as the assurance of a safe and constant revenue to the State from forest property, and therefore the possibility of a reduction of taxes, the power of controlling and maintaining the timber supply, the opportunity in cases of emergency of raising loans on such property, all such considerations must only be allowed as secondary and will eventually help to strengthen our argument in favor of Government lands.

If the forests of a country were nothing but ordinary property, just as a house, a mine, or a farm, we would contend, that the State should not own and manage forests, that their utilization should be entirely regulated by the effects of supply and demand and agreeably to the individual interest of the moment, which, according to Adam Smith, is the only rightful motive in the use and disposal of property. But there are properties over which the right of eminent domain would be allowed to the State even by the most radical economic reformers. Such things as are of importance to the safety, well being, and happiness of the whole community, like the air, the waters, streets and roads, cannot be entirely given up to individual disposal without injury to a large part of the community.

The experiences of nearly every European country during the first decades of this century have practically proved that the liberation of forest property from all restraint—while, according to Smith, it should have led to the highest economic development—has bred devastation and destruction not only to the property from which the forest had been wantonly removed, but to the agricultural interests and economic prosperity of the whole surrounding district.

Modern investigations have left no doubt that the presence or absence of certain percentage of woodlands has a decided influence upon the climate of a country; modern experience has taught that the destruction of forests on headwaters is apt to paralyze the regularity of the water-supply and at enormous cost to communities has bred alternate floods and droughts.

History of all times and nations has shown that by wanton abuse of forest properties industries have been destroyed, agricultural lands have been laid waste, civilized districts have been made uninhabitable and turned into deserts and the inhabitants have been reduced to poverty.

It is a peculiarity of systematic forest economy that it must work with a large capital stock of timber, which, accumulated through long years, may be utilized at any time. Therefore an increased demand for lumber may be satisfied by diminishing the capital stock. The financial interests of the private forest owner will in most cases induce him to use this

means of meeting the increased demand, and to take advantage of the higher market price rather than to increase production by more extensive plantations. These would only after many years yield a useful material, and therefore the advantageous market price, stimulated by present demand, might not be secured. Forest devastation is then the natural consequence of the application of this rule of demand and supply.

Recognizing, then, the significance of the climatic and hydraulic influences of the forest, it will become necessary to revise the principles of statesmanship which treat of State property and of the relation of the State to forest owners. Where the common weal and the economic development of the whole community is concerned, the Government must have the right and the duty to exercise eminent domain and to interfere with the use of this class of property. But there will always be a strong feeling against the exercise of such right on the part of the State; even the republican spirit of the free citizen will rarely be exalted enough to allow interference with his property rights for a benefit to the community, which he may not even recognize.

It will, therefore, seem advisable that the State itself should own those forests, the existence and continuance of which as such, is necessary for the agricultural and general interests of its citizens. Since these lands are mostly unavailable for any other purpose than forest growth, since forestry on such lands is by no means as profitable a business as a private individual would care to carry on, and since by a management of these forests under Government a continual timber supply is guaranteed to the surrounding country, it should not be a difficult matter to retain or else to acquire such property either in the way of regular purchase, based on tax valuation, or by expropriation in consideration of public interest.

From the foregoing remarks it will appear that the value of Government timber lands cannot be ascertained on such basis as that of ordinary property of private individuals and on mercantile considerations only. The value of this kind of property is of a higher order. It is not equal to the value of the crop or the productive value of the soil, nor to the combined value of these two factors. Their value is not represented by the selling value of either or both.

Where the land is held for purposes of colonization the price ought to be far below its real or market value to *actual settlers*, in order to offer an inducement. But where forest land is held by the State for considerations of public welfare, as pointed out before, its value is *incalculable*—and as to price, it should be out of the market altogether. If managed on true scientific and systematic principles, such forests will attain the additional value of educators, serving as a school and example to private forest owners.

In Prussia, where only one-fourth of all the forests is held by the State, the large class of private owners have greatly benefited by the example of the Government and availed themselves of the experience

and advice of the officers, educated for the Government service, and systematic management with a view of continuity has become the rule.

Which of the lands now in possession of the General Government fall under the first class—held for colonizatory purposes—and which should be classed under the second, it is impossible to determine without at least an approximate forest survey. Such survey may easily be made in connection with the geodetic surveys and geographical explorations already established, and need not go into further details than locating and mapping in approximate measurement such districts, which should be exempted from sale on account of their unfitness for agricultural use or for reasons of their climatic, meteorological, and hydraulic influence.

Care should also be taken not to dispose of any lands except to settlers, and that no lands be sold which are only fit for forest growth.

By making sales to settlers subject to a condition, requiring them to keep a certain part of their entry in forest under the supervision of the nearest Government forest officer, an intelligent class of small forest owners might be quickly educated. In the management of Government timber-lands the financial effect should be only secondary, and the continuity of the forest should be of more account than the demands of the lumber market.

I do not advocate an expenditure of money for the purpose of keeping forests intact; but I believe that a Forest administration for the Government timber-lands, either of a State or of the United States, can be devised and maintained, and that at this present day, which will not only pay its own expenses from the sale of ripe timber, but which, besides answering all the purposes of protecting our water supply and our climatic conditions, will yield a handsome revenue and furnish sufficient means for acquiring and reforestating such localities as should be preserved in forest.

What methods should be applied in regard to the details of management it is now too early to discuss.

The present meager appropriations of the General Government are but a drop in the ocean, and are more likely by their insufficiency to bring discredit on those who attempt to accomplish with them anything of value than to promote very much the forest policy of this country.

It seems a short-sighted policy, indeed, which neglects to take proper care of so valuable a property as the forests of the public domain now are, and which could be made much more valuable by proper management. Until recently, according to the Commissioner of the Land Office, the depredations on this State property must alone have amounted yearly to several million dollars, of which only a small part, at heavy expense, may be recovered, whilst the inauguration of a Forest department, with a view of actually managing the domain according to the principles laid down before, would cause the dead capital stored in these forests to pay the interest on any appropriation which might be made for it.

The following figures, from the Forest administration of Prussia and other States of Germany, a country in which the Government forests are notably very excellently managed, on the most conservative principles, may serve to form an idea what such an administration can be expected to yield.

The total area of Prussia comprises 89,000,000 acres. Of the 23.3 per cent. of forest land, the State owns only 29.4 per cent., representing an area of 6,000,000 acres. The administration of this area* with all its incidentals, as forest schools, experiment stations, &c., required a force of officers of different grades, and guards numbering nearly five thousand; the expense of this part of the administration amounted to nearly $3,000,000.

A large force of laborers, having the benefit of work all the year round, is employed in planting and lumbering.

The cost of lumbering and expenses of transportation amounted to		$1,750,000
For cultivation, improvements, roads, &c		1,000,000
For taxes and other obligations		250,000
Total expenditures		6,000,000
Or $1 per acre.		
Receipts for timber and cordwood	$12,250,000	
Other revenues	1,000,000	
Total receipts		13,250,000
Leaving a net profit of		7,250,000

This result, representing a net profit of 52.5 per cent. of the receipts, has been obtained by selling the ripe wood at an average price of not quite 6 cents per cubic foot in the woods. In recent years the expenditures have been increased by buying up waste lands fit only for forest culture. To show how this record of poor and economical Prussia compares with other German administrations we have compiled the following figures:

In the year 1882, the following results were obtained for 1 acre of forest land:

	In fourteen States (average.)	In Bavaria.	In Prussia.
Total receipts	3.04	3.88	2.08
Expenses of administration	0.52	0.54	0.46
Other expenses, lumbering, &c	0.60	0.60	0.44
Total expenditure	1.12	1.14	0.90
Net profit	1.92	2.74	1.18

It may be interesting to know the result of the forest administration of so small a State as the little dukedom of Saxe-Gotha, which has just come to hand, for the year 1882. Its forest area is only 80,000 acres, of

* The following data are compiled from the official reports, and represent averages during the years 1870 to 1879.

which 78 per cent. are in fir and pine. The cut for 1882, was 22,000,000 feet of logs and 18,000 cords of firewood.

The receipts from this were $382,000, or 10 cents per cubic foot. Other revenues brought the receipts up to $386,000, or nearly $5 per acre. The expenditures were—

For administration	$49,000
For roads	10,450
For cultivation, for which 760 acres or 0.95 per cent. of the forest area were replanted	8,300
For lumbering	73,600
For surveys, destroying of insects, &c	7,000
Total expenditures, or $1.85 per acre	$148,350

Therefore net proceeds $237,700, or $2.97 per acre; *i. e.*, 67.1 per cent. of the receipts.

THE PRESERVATION OF FORESTS ON THE HEADWATERS OF STREAMS.

By M. C. Read.

The Mississippi Valley has an extreme breadth of over 33° of longitude, and a length of over 20° in latitude, embracing more than one-half of all the territory of the United States.

The Mississippi River stretches its arms from east to west until they embrace in their grasp nearly one tenth of the earth's circumference.

If in this valley were gathered all the Caucasian race, there would be a population of only about 370 to the square mile; and if all the inhabitants of the earth were gathered into it, the population would not overcrowd it. Its fertility is almost as unexampled as its size. Deducting the arid portion of the West, there is nowhere else on earth an area of one-half the size of unbroken land of equal fertility and productiveness, or capable of supporting so dense a population. The question of the future of this great valley is of so vast importance that imagination can hardly grasp it. Shall the arid climate of the West creep steadily eastward, till its hot breath parches the slopes of the Alleghany Mountains, or shall our tillage, with ever increasing returns, be extended steadily westward till it reaches the base of the Rocky Mountains?

Man is now the potent agent in geological and climatic changes. He is profoundly modifying the whole of the surface of the earth. He has changed the vast territory of western Asia, whose agricultural products once supported the dense populations that lived under the ancient monarchies, into an almost desert waste. The wise Solomon and his ally, King Hiram, in the destruction of the cedars of Lebanon, commenced a work which has rendered a land once flowing with milk and honey almost barren.

If our work in the great Mississippi Valley is having a permanent effect upon its future fertility we cannot scrutinize too closely the character of that work and its tendency.

We are tenants for life only of this vast inheritance we have received from our fathers. The remainder-over belongs to those who are now unborn—to whom we are bound to leave it with its productiveness unimpaired. Each life tenant is too prone to disregard the rights of those entitled to the remainder-over, and to make what he can from his tenancy, regardless of its effect upon the future value of the estate. When the prophet warned good King Hezekiah, that after his death all the treasures of his home should be plundered and his sons carried into captivity and dishonored, he wrapped the mantle of his own selfishness around him and said, "Is it *not good* if peace and truth be in my day," although fully advised that the coming calamities were the result of his own misdeeds.

In the unadvised and unrestrained acts of the life-tenant the rights of the remainder-men are never safe. A little immediate advantage far outweighs all future and contingent evil. And right here is one of the most important duties of every Government, which it cannot neglect without being false to its most important trust. It is bound to thoroughly enforce that wise maxim of the law, that each one "shall so use his own as not to injure another," and to include in that word "another" all who shall come after him. Government is the trustee of the future proprietors, and is bound to take all action which may be necessary to secure to them their rights, among which is the enjoyment of their inheritance with its productiveness wholly unimpaired. A failure to do this has not only destroyed great empires, but has left the land in such a condition that it could not support a great empire.

It is regarded as demonstrated, that in a wide area of agricultural land, when one-fourth of it is retained in forests, the residue will, year by year, yield more agricultural products than the whole would if cleared and subjected to tillage, and there is no other place in the world where the danger from forest destruction is so great as in the Mississippi Valley. At the headwaters of most streams nature has provided for the perpetuity of the forests, by leaving the land in a condition unfitted for anything except forest growth, and when the streams and the valleys are small, these lands, condemned by nature to forests, may suffice for all climatic influences. But the area of tillable land in the Mississippi Valley is so immense, and the temptation to forest destruction so great, that we are in danger of being ruined through the very munificence of nature.

Practically the whole of this valley is capable of being put under tillage, and personal greed is tending to this result, and very clearly is tending to its *diminished* fertility and quite probably to the complete *destruction* of its fertility. A possible result so appalling cannot be contemplated without serious apprehension.

But climatic influences are so slow in their action, taking so long a time to demonstrate their tendency, that it is a hard task to persuade more than a very few of their real tendency.

But the attempt to put certain lands under tillage which nature reserved for other uses has already produced most disastrous results, which, it is believed, will be recognized by all as soon as pointed out, and it is to our errors in this respect that this paper will be mainly devoted.

The sources of nearly all the tributaries of the Mississippi are found in a series of swamps and lakelets, which, receiving the drainage of adjacent higher land, furnish a perennial flow of water as the commencement of each tributary. The gentle divide which separates the waters of the Ohio from Lake Erie is dotted with such swamps and lakes. A map on a large scale of Northern Wisconsin and Minnesota exhibits as its most marked characteristic a multitude of such lakes; and in the mountainous regions of Pennsylvania and Virginia elevated swamps or lakes are found at the heads of very many of the streams. Taking the whole of this great valley and as a rule, to which there are only few exceptions, the beginnings of the streams are in swamps and lakelets.

Their function in the drainage system of the valley is best understood where man has not interfered with it; where the lakes are often surrounded with marshes, generally with forests containing a dense undergrowth of shrubs and sphagnous mosses, where the swamps are almost impenetrable, filled to a great depth with a peaty growth which in places has bridged over and covered a buried lake, receiving the drainage from a large surrounding wooded area, the outlets of swamps and lakes alike choked with a dense growth of aquatic plants, all constituting a series of reservoirs from which the water runs off slowly, from which there is a large evaporation, and from which the downward drainage into the soil and the deep rock strata below is never interrupted.

Their presence turns back by evaporation into the air much of the rainfall, fills the rocks below with subterranean streams, which are the sources of all the perennial springs, and so regulates the outflow of the surplus water as *tends* to maintain an equable flow throughout the whole year. If these natural reservoirs were large enough this result would be obtained, the flow of all the streams would be substantially uniform, and we should never hear of destructive floods on the larger streams. The flow of water in Detroit and Niagara rivers is substantially uniform, except as the level of the lakes above is changed by the force of the wind.

These primitive conditions have been greatly changed. The clearing of the higher land has caused the surface water to flow more rapidly into these lakes and swamps.

When it was learned that if reclaimed the swamps would constitute some of our most productive lands, the work of their extermination was commenced and pushed with vigor. In most States ditch laws were

enacted, by which a majority of the owners of any body of swamp lands could compel the others to contribute their proportion to the systematic drainage of the whole.

The surface of the swamps being generally found on the same level as the surface of adjacent lakes, it was found that the outlets of these must be deepened and broadened, to secure the drainage of the swamps, and to provide for the prompt outflow of the water which now, without any retardation, found its way into the swamps and lakes.

To accommodate this more rapid outflow, the streams below have been often straightened, obstructions removed, and the rapid concentration of the water into the larger streams made as easy as possible. In much of the remaining forest the destruction of the large timber trees has made openings for the sun, the underbrush has been destroyed, the intrusion of domestic cattle has carried the seeds of the grasses, and these wood lots are being converted into wood pastures. All these agencies combined are making the surface drainage almost as perfect as if a series of impervious roofs covered the land and all the flow from them was conducted by pipes into one common channel.

The results are not matters of speculation, but can everywhere be observed. Springs once copious have disappeared; streams formerly perennial alternately overflow their banks and run dry. The natural regulators of the streams having been destroyed, whenever there is an excessive rain it is rapidly carried into the streams which, gradually uniting their waters, often constitute floods in the larger channels which no human appliances can control. By a system of dikes and levees we may do something to check the evil for a time, but we shall certainly make it greater in the future. The stream confined to its channel will deposit sediment upon the bottom, gradually raising it above the level of the adjacent land, and then when breaks occur in the dikes the results will be unspeakably disastrous.

This work of destroying the natural regulators of our streams and cutting off the sources of supply for the springs, is not wholly accomplished, but is pushed with vigor every year. Additional swamps are reclaimed each year, the drainage in all made more perfect, the soil compacted by continual cultivation until it loses entirely its spongy porous character, the wash of sediment into the lakes is greatly facilitated by the clearing and cultivation of the adjacent land, so that by a steady silting up of the bottom, and by the enlargement of their outlets, their capacity is rapidly diminished and their future obliteration rendered inevitable, unless something is done for their preservation.

The future results are not uncertain. Every succeeding year a definite rainfall in a given time will result in a more destructive flood than ever before. A drought of the same duration will leave more and more of our streams without water, and springs which have heretofore been perennial will cease to flow. Our wells will not escape the results of these influences, and more of them will go dry.

There is but one possible remedy for all of these evils. It is for us to cease to do evil, and to learn to do well; to hasten as quickly as possible to undo our work and recreate the natural reservoirs we have destroyed. By reforestering these swamps and the higher land which surrounds them and the lakes, we shall restore them to their proper place in the economy of nature. The abundance of moisture will make this work comparatively easy, as it will insure a rapid growth of trees and shrubs. Swamp oaks, white maple, black ash, tamarack, and pine are among the valuable trees that find a congenial home in all such swamps. For the higher ground around, other valuable trees should be selected. But it is not alone what are called valuable trees whose growth should be encouraged. In all forest culture it should be remembered that, for climatic purposes, an orchard of forest trees is not a forest. The planting of trees along the highways, about our homes, in parks and groves, ought to be encouraged for a variety of reasons, but will have little of the climatic effect of true forests. A dense growth of underbrush, herbaceous plants, and mosses under the larger trees, which will retain the fallen leaves in place, fill the surface soil with rootlets, checking the flow of water and facilitating its entrance into the earth, are essential parts of a true forest. They also tend in all seasons to maintain that moist condition of the soil and air which is essential to the vigorous growth of the larger trees. Fortunately a multitude of such shrubs and plants will spring up on all this swamp land as soon as it is devoted to forest growth and protected from the intrusion of domestic animals.

The lakes should be restored to their former dimensions, and wherever practicable enlarged by damming their outlets. Fortunately the attention now given to the artificial propagation of our food-fishes favors this work. It is claimed with a good probability of truth that a lake well stocked with fish will produce as much food as the same area of land devoted to the raising of ordinary field crops, and it is more than probable that the annual forest growth of the swamps and the fish products of the lakes combined, will be of much more value than the agricultural products which can be obtained from the swamp lands alone.

But the prospect of immediate returns, with most men, so far outweighs the advantages of prospective greater returns, that few, without some additional inducement, will be persuad ed to devote to forest growth the swamp lands which they have fitted for tillage with so much labor. While they know that they are not permitted to so drain their lands as to flood injuriously the land of an adjacent proprietor, they will ask, "Why shall I abandon what seems to me the best use of my own land because of supposed injury to those who are thousands of miles away?" The injury is so remote, and the responsibility so divided, that no one feels personally responsible for his share in the results. Governmental aid, State or national, in the way of bounties, exemption from taxation, or in some other mode, is essential to the securing of the devotion of these

lakes to fish preserves, and of these swamps to forest growth. The people at the head of the streams readily consent to be taxed for the really fruitless and irrational work of constructing dikes on the banks of the Mississippi; and the time will certainly come when those now injured by the floods will turn their attention to the real causes of the evils they suffer, and will gladly consent to be taxed for the purchase and governmental control of all these lakes and swamps. They will see that the only remedy for the calamities they encounter is to *regulate* the flow of the water in the river, instead of attempting to control it when it has become uncontrollable.

The restoration of these natural regulators will not accomplish all that is desired. It will be an important step in the right direction, and a reliable guide to supplemental efforts; for the waters of the Mississippi and its tributaries are as thoroughly under our control as is the water supply of any great city. We can prevent *all* destructive floods, and secure such a uniform flow as will prevent any interruption of navigation in the principal tributaries during the most protracted drought.

In 1849 Charles Ellet, a civil engineer, contributed to the Smithsonian Institute a paper, which was published in the second volume of its Contributions, "On the physical geography of the Mississippi Valley," the object of which was to outline a plan for the improvement of the Ohio River by securing such a constant flow of water as would prevent all interruption of navigation. This problem he solves, and he incidentally solves the problem of the means of preventing all destructive floods.

He gives, in a series of tables, the daily flow of water over the Wheeling bar for a number of years, and figures the capacity of reservoirs at the head of the streams which, filled at the time of heavy rains and retained until needed, would suffice, in times of natural low water, to maintain a sufficient flow over the bar to prevent all interruption to the navigation of the stream.

He computes also the volume of the destructive part of the water of the great flood of 1832, when the water rose at Cincinnati to the height of 63 feet above low-water mark, and demonstrates the practicability, at a comparatively trifling expense, of so controlling it, and all other similar floods, as to make them absolutely harmless.

On page 48 of his paper he says:

> Although in this paper the computations have only been made to the reduction of the extreme height of the flood mark, so as to show that it is quite practicable to render it harmless, there are many interests in society which would be promoted by a further extension of the system and an ultimate approach toward an equalization of the daily discharge. It is quite reasonable to suppose that in course of time all the waters of all the navigable rivers will be required to supply the wants of man and his commerce. Reservoirs may eventually be made of sufficient capacity to hold *all* the annual excess and make the daily flow almost entirely uniform. The banks of the Ohio and Mississippi, now broken by the current and lined with fallen trees, ready to be swept by the next freshet into the channel, there to form dangerous snags, may yet in the course

of a very few years be cultivated and adorned down to the water's edge. In the opinion of the writer, the grass will hereafter grow luxuriantly along the caving banks. All material fluctuations of the water will be prevented, and the level of the river surface will become nearly stationary. Grounds which are now frequently inundated and valueless will be tilled and subdued; the sand-bars will be permanently covered, and, under a uniform regimen of the stream, will probably cease to be produced. The channels will become stationary. The wharves will be built as the wharves on tide-water, with little if any reference to the fluctuations of the surface. The lower streets of all the river towns, no longer exposed to inundations, will acquire new value. The turbid waters will be arrested in the upper pools, and the Ohio first, and ultimately the Missouri and Mississippi, will be made to flow forever, with a constant deep and limpid stream. The ice will be swept off as it forms, and neither cold or droughts will longer be suffered injuriously to affect the navigation. The ocean steamers will not then be confined to tide-waters, but will be able safely to ascend the living streams to sea-ports on their borders, and the extent of the inland navigation will be limited only by the limit of the water which is supplied by the atmosphere.

All this may be accomplished on the Ohio *for about the cost of three or four ships of the line.* The great and only difficulty is to overcome the cold incredulity of the public, so as to induce those in power to grant a sufficient appropriation for the completion of the first two reservoirs. This once accomplished, and a single practical demonstration made, it will be difficult to convince the future engineer that a thing so clear and palpable could ever be doubted.

As an effort of art, the work of controlling the floods of the great rivers of the Mississippi Valley will never compare with the labors of men in other departments of practical service. More money has been laid out on 3 miles of railroad than would be needed to maintain the waters of the Ohio within 2 feet of a uniform height throughout the year, to add a length of several hundred miles to the river navigation of the country, and render more than 2,000 miles of precarious navigation permanent and certain. The same reservoir that keeps back the excess of water from the tributary keeps it back also from the recipient stream; the same supply that maintains the navigation of the tributary also improves that of the recipient; and the same reservoir that serves to maintain the navigation of both tributary and recipient, serves of necessity to protect both from overflow.

These things will be effected, not by main force but by skill. The rain-gauge will indicate the approaching danger from the summits of the distant mountains; the telegraph will announce the fact at the flood-gates, and the whole may thus be controlled by the previsions of science. In fact the desired effect can be produced by a few dams in the mountain gorges, and the constant attention of some twenty men.

On page 54, speaking particularly of the improvement of the Ohio, he says:

It has been the duty of the writer, at former periods, to conduct surveys along a considerable portion of the Upper Alleghany and the whole of the Great Kanawha, and to become familiar with the character of the Monongahela as far as it is susceptible of improvement. Aided by this personal knowledge and the facts acquired in the present investigation, he hazards the opinion, that less than $1,250,000 will suffice to supply the Ohio with a depth sufficient for boats of 5 feet draught; to carry on open and permanent river navigation during three-fourths of the year, from Franklin to the line of the Erie Railroad in New York; improve the navigation of the Monongahela into Virginia, and extend that of the Kanawha 70 or 80 miles above Point Pleasant—supplying water-powers of unrivaled capacity and permanence on numerous lines of steamboat navigation, and curbing most essentially the destructive power of floods.

Viewing the insignificant cost for which about 1,400 miles of river navigation may thus be rendered permanently available—without reference to the incidental advan-

tages that will flow from the work—it may well be doubted whether there is, in the whole circle of contemplated public improvements, a projected enterprise which more seriously demands the care and consideration of those who are charged with the protection of the public interests.

The difficulty which the mind first encounters in contemplating this proposition arises from the apparent immensity of the mass of waters to be dealt with. But this is only a speculation. The quantity has been *measured* and found to be easily attainable and perfectly manageable.

The total discharge of the Ohio, in ordinary low water, is but 6,000,000 cubic feet per hour. A pipe no larger than one of those used for conveying the water of the Croton water works—or 3 feet in diameter—will discharge very nearly 1,000,000 cubic feet per hour, under a head of 60 feet. Six such pipes, then, placed in a dam only 60 feet high, and provided with proper valves, would emit water enough to double the quantity flowing down the Ohio at its usual summer stage. And if there were three such dams, on different streams, and twelve pipes in each, and one man to superintend each dam, and obey the telegraphic signal to open or close the valves, or an equipment equal to three dams, no higher than have already been built in this country, and thirty-six pipes, equal in diameter to the mains in Broadway, and three men to manage the whole, the quantity of water could be increased sixfold, and the navigation could be maintained above 5 feet during all ordinary droughts. At the same time, such is, happily, the form of many of the Western valleys, that dams of double this height can be often erected without injury, to any appreciable amount, of property improved or susceptible of improvement.

While the author probably underestimates the cost of these improvements, he certainly demonstrates their practicability, and at a cost very much less than the damages resulting from a single great flood.

The great excellence of this system is that it supplements the agencies which nature provides to subserve the same ends, co-operating with them and extending them. The work accomplished by the natural lakes and swamps, which has already been outlined, would also be accomplished by these artificial reservoirs, and to a degree exactly proportioned to their relative size. A large percentage of the retained water would be carried deep into the earth, establishing subterranean streams, from which copious perennial springs would be produced, while from their broad surfaces an additional amount of water would be evaporated into the air, to be again precipitated in refreshing showers.

Artificial lakes thus formed at the headwaters of the Missouri River would load with moisture the dry winds sweeping over them toward the plains, where it would probably be often deposited in copious showers; the seepage downwards would find underground channels which here and there in the plains below would break out in perennial springs and to some extent, at least, convert a desert into fruitful fields.

It has been the dream of some that the time was coming when copious showers could be called from the heavens at the will of man, and injurious droughts become unknown. This is doubtless only an utopian dream, but the rain that does fall is subject to man's control. He may utilize it all to his advantage; during excessive rains he may hold back all that part of it which without his interference would constitute an injurious flood, and with that thus retained maintain a perennial and nearly uniform flow in all the streams.

With a proper amount of restored forests, with our natural reservoirs enlarged and preserved, and artificial lakes established at the heads of the streams of a capacity sufficient to regulate their flow, evaporation would be largely increased. We should attack the arid plains of the West upon both flanks at once, and if our agency can convert them into fruitful fields it will be accomplished in this way. It is certain that our work hitherto has tended in the opposite direction. Our hastening the downward flow of the water, has tended to diminish local evaporation, our destruction of the forests local precipitation, and, if continued, there is great danger that the line which marks the eastern margin of the arid region will move steadily eastward until it crosses the Mississippi, and, perhaps, checked by no barrier, until it reaches the base of the Alleghanies.

These probable results, involving on the one hand calamities so appalling, and on the other benefits so far reaching, demand the most careful consideration on the part of the science and the statesmanship of the whole country. It is a question of vastly more importance than all the questions upon which political parties are formed, and which, if properly appreciated, would make those questions seem in comparison childish and of little account. In the destiny of the Mississippi Valley is involved the destiny of the whole American people. It feeds the cities and manufactories of the East, and the mining towns and centers of the West, while it largely absorbs the products of both. It is a fitting time to inquire in regard to it, What are its tendencies for the future? Clearly those tendencies now are in the wrong direction, a tendency to an ever diminishing power of production which will end, we know not where. Statistics of crop productions will tend to mislead us. Every year an immense territory of virgin soil is subjected to the plow, and improved modes of culture are increasing the products of the old farms, but it is not what it in fact produces, but what it is capable of producing and will be capable of producing in the future, that is to be considered in this discussion, and there can be no doubt that present influences are seriously threatening its future power of production.

Toward resisting this tendency something may be done by individual efforts, by warning, by appeal, by disseminating a love for forest culture, and a just appreciation of its monetary value; by our Fish Commissioners, encouraging the appropriation of all small lakes and ponds to the artificial rearing of fish; by our State legislatures, by premiums, bounties, exemption from taxes, or in some other way securing the reforesting of the swamps and hills at the heads of all the streams; and by the General Government supplementing all this work in the way proposed by Mr. Ellet in the paper already quoted. While the certain direct results, in improved navigation and immunity from floods, and the probable results in climatic influences, would pay a thousand fold for the money required to equalize the flow of water in all the larger streams of the Mississippi Valley, there would probably result inci-

dental advantages fully equivalent to the entire cost. For every acre of comparatively barren land at the heads of the streams which must be appropriated for these reservoirs, very many acres of alluvial land, of unsurpassed fertility, on the borders of the larger streams, would be redeemed from the water and made available for tillage. The immense water-power created by these reservoirs, when it all becomes finally utilized, would of itself probably pay for all the cost of the dams. The artificial lakes stocked with fish will yield a much larger food supply than the lands covered by them could be made to produce. However great may be the expenses, the benefits resulting will be immeasurably greater. And if the work is well done, so as to avoid all danger of the breaking down of the dams, imagination can picture no possible evil tendency.

The thorough control of that part of the rainfall which fills the streams is sure to be one of the most important triumphs of practical science. This country is to be the pioneer in the work, or the imitator of others.

With an overflowing treasury, filled without any perceptible burden to the people, we are in a most favorable position to commence this work. Its thorough application to the Ohio River would be easy, and not expensive. Its practicability thus demonstrated, it would ultimately be applied to all the rivers of the country, which would be made to flow in limpid streams at substantially the same level throughout the whole year. The whole of the rainfall would become beneficial, and all apprehension of destructive floods would cease.

Manufacturing interests, having other ends in view, have already substantially accomplished this on some of the New England streams. Dams erected to secure water-power have established reservoirs which practically control the flow of water on streams where the natural drainage is so rapid as to make them peculiarly liable to floods. Here the prime object is the production of water-power—the incidental result, exemption from floods. In the plan proposed the prime object is exemption from floods, the incidental results are improved navigation, an almost measureless production of water-power, and climatic influences, which, while they may be slow in their manifestation, will be steadily increasing and wholly beneficent. Is it not fitting that the people of the United States should be the pioneers in this great work?

One additional suggestion should be made. The arid lands of the West must be flanked, not attacked at the center. Forests must be created upon their borders, not in their center, for there they cannot be made to grow until a humid condition of the soil and the air is first produced. An important beginning has been made in Colorado by diverting the water of the mountain streams into irrigating ditches, and the subjection of large areas to profitable cultivation. From the surface of these ditches the evaporation is rapid and continuous, and substantially

all the water actually used for irrigation is returned to the air by surface evaporation and exhalation from the leaves of cultivated plants.

This system, extended along the whole of the eastern slope of the mountains, will return to the air nearly all thewater diverted from the streams, which from the direction of the prevailing winds will be carried over the plains and fall in showers. The artificial lakes already suggested, discharging the same functions, can be made largely available for irrigating purposes, and there is little doubt that by these means the amount of land on the western border of the plains, put under cultivation, could be steadily and indefinitely increased, so that if conservative measures are adopted on this side also and vigorously prosecuted, the whole of the arid plains would ultimately be redeemed and subjected to profitable tillage.

The moist winds from the Pacific passing over the broad ranges of the Rocky Mountains are deprived of their moisture, and as they fall over the eastern slopes are fitted to absorb rather than precipitate moisture. Moving eastward and mingling with the moist winds from the south and southwest, they increase the capacity of the latter for moisture and diminish the amount of precipitation from them. Let these thirsty winds as they strike the plains become saturated with moisture from artificial lakes, irrigating ditches, cultivated fields, and forests, when they meet these southern winds, instead of preventing, they would facilitate precipitation, and secure rainfall on the plains. It is, as has already been said, a useless work to attempt to plant forests in the arid region. Its arid character must be changed before the forests will grow. The work must be commenced upon the margin and gradually carried into the interior. The Government aid should be directed toward securing, by means of irrigation, the cultivation of as large areas as possible on the western margin of the arid plains and the planting of forests there. We *can* conquer the whole of them and make them available for tillage if all judicious measures are adopted and perseveringly followed.

It is for the people of the United States to determine whether the boundary of this arid region shall be extended indefinitely eastward, or whether the eastern and western boundaries of it shall slowly but steadily approach each other until the arid region disappears.

The magnitude of the work proposed, and the immense amount of water to be controlled, will naturally suggest to many the idea that the scheme is wholly impracticable. But the amount of rainfall over this whole area is now very accurately measured, and it is known that about 40 per cent. of it finds its way into the larger streams. This has been measured in the Ohio, and can be measured in the Mississippi and all its tributaries. The measurement of the flow during the highest floods will show with mathematical exactness just how much must be held back at the times of the greatest danger, to entirely obviate it. This will give us the exact aggregate capacity of all the regulating reservoirs

required. Surveys at the heads of the streams will show where dams at least expense will suffice to hold back the drainage from the largest areas, and will, it is confidently believed, show that the plan is entirely practicable and the cost trifling and insignificant, when compared with the beneficent results which are sure to follow.

THE DISTRIBUTION OF NORTH AMERICAN FOREST TREES.

By Dr. George Vasey.

While we are considering the subject of forestry, and the grave and important question of conserving our great forests from needless waste and destruction, it may not be without interest to take a botanical glance at the composition of these forests and of our woodlands in general. Not only is our country vast and possessed of extensive forest lands, but these forests and arboreal districts are extraordinarily rich in the number and variety of species presented. Outside of the tropical regions probably no part of the globe presents a greater diversity in an equal area.

To show by comparison the richness of our forest flora, we may place in contrast that of Europe, which furnishes little over 100 species of trees, while within the boundaries of our own country we have about 400 species. Estimates of the number of species of trees growing within our limits will, of course, vary with the standard which is assumed as the proper height and size of a tree. The dimensions of trees and shrubs vary considerably in different localities, as influenced by climate, soil, and altitude, so that a tree of good size in some localities may in others be reduced to a shrub. Generally, those plants which are destined to become trees have from the first an erect and firm woody stem, but there are some exceptions to this rule. The flowering Dogwood, *Cornus Florida*, as commonly found in the northern woods, is a straggling bush, but individuals frequently assume an erect trunk and attain the habit and size of a moderately large tree. The *Magnolia glauca*, or White Bay, grows and flowers freely in some portions of Massachusetts, where it attains only the size of a shrub. It, however, steadily increases its size in situations farther south, until in Georgia and Florida it frequently becomes a large tree. In some places, also, the same species appears as a shrub or a large tree, in closely contiguous localities. One of the maples of Oregon is called the Vine Maple, because the stem is at first weak and forming tangled thickets, but some of these stems finally become erect or oblique, and acquire the body and height of pretty large trees.

Generally those plants which are designated as shrubs are not only low in stature, but have the habit of growing in clumps, or developing a great many stems from one main root. In other cases they throw out

numerous stolons and multiply their stems so as frequently to constitute a thicket of bushes.

I think it will be in accordance with general custom to assume that those woody plants which have an erect habit, and ordinarily attain a height of 16 to 20 feet or more, may be counted as trees.

With reference to its vegetation, the territory embraced within our limits may be primarily divided into three regions, but each of these regions includes great variations of climate (which are characterized by peculiar floras), and is therefore subdivided into secondary regions or districts.

1st. The Atlantic Region embraces all that portion of the country from the eastward slope of the Rocky Mountains extending eastward to the Atlantic Ocean.

2d. The Pacific Region embraces California, Oregon, and Washington Territory and the mountain ranges of the western coast.

3d. Lying between these we have an Interior Rocky Mountain Region, embracing the Great Interior Basin with its mountain ranges, the chain of mountains extending through New Mexico and Colorado, and the country southward bordering upon Mexico.

Passing to a more detailed account of the main Regions, we find that in the Atlantic Region we have to make several subdivisions. In the southern portion of Florida we have a very distinctive semi-tropical flora, furnishing about sixty species of trees which appear in no other part of our boundaries, which are mostly identical with existing West Indian species, and are probably descendants of a vegetation which existed at a period when there was land connection between Florida and the West Indies. As very few of these sixty species have any relatives in the other botanical Regions, it will not be necessary here to make a special enumeration of them.

The region lying north of this subtropical district presents a great variety of climate, but it is difficult to draw any close line of separation into sub-regions. Looking at the extreme northern and the extreme southern portions of the territory there is a very strong contrast in the forest productions. Hence we may say that there is a northern and a southern Atlantic division. But the climatic variation of this region is much broken by the Apalachian chain of mountains which provides a pathway by which many of our northern trees penetrate into the States of North Carolina and Georgia. Therefore the number of trees that may be considered strictly northern are few—perhaps less than a dozen of these extend beyond the Arctic circle. These are chiefly the following: Black Spruce (*Picea nigra*), White Spruce (*Picea alba*), Balsam Fir (*Abies balsamea*), Balsam Poplar (*Populus balsamea*), Aspen (*Populus tremuloides*), Canoe Birch (*Betula papyracea*) and Larch (*Larix Americana*). Beside these there are a few which find their northern limits near Hudson's Bay, and seldom pass below the forty-second parallel. These are the Scrub or Banksian Pine (*Pinus Banksiana*), Norway Pine

(*Pinus resinosa*), White Birch (*Betula alba* var. *populifolia*), Yellow Birch (*Betula lutea*), and Arbor Vitæ (*Thuja occidentalis*).

Of the above a very few, namely, the Balsam Poplar, the Aspen, the White Spruce, the Red Cedar, Cottonwood (*Populus monilifera*), the small Mountain Ash (*Pyrus sambucifolia*), the Black Thorn (*Cratayus tomentosa*), the Box Elder (*Negundo aceroides*), and two or three willows, pass across the continent to the northward, so as to be represented on both sides.

But a large number of forest trees of the Atlantic Region range from New York and the Great Lakes southward to the Gulf of Mexico; among these are many Oaks, Hickories, Maples, Ash, several Poplars and Pines. Quite a number of trees seem to be most at home about the middle region of the district extending both northward and southward.

With respect to a large number of the forest trees of the Atlantic Region the line of the thirty-seventh parallel may be taken as the separating line between those which may be called northern and those called southern; those of the one kind seldom passing south of that line, and those of the other kind seldom passing further north.

Among the more characteristic trees of the southern district we may mention five Magnolias, one Prickly Ash (*Xanthoxylum Carolinianum*), one *Holly*, one *Cyrilla*, one *Cliftonia*, one *Sapindus*, two Locusts (*Robinia pseudacacia* and *R. viscosa*), one *Prunus*, one Wild Crab Apple (*Pyrus angustifolia*), five Wild Thorns (*Cratægus*), two *Tupelos*, one Sorrel Tree (*Oxydendrum*), three *Bumelias* (Iron Wood), one Sugar-leaf (*Symplocos*), two *Halesias*, one Ash, one *Forestiera*, one Fringe Tree (*Chionanthus*), one Devil Wood (*Osmanthus*), one Catalpa, one Winged Elm (*Ulmus alata*), one *Planera*, two Hickories, six Oaks, one Swamp Poplar (*Populus heterophylla*), one Cypress (*Taxodium distichum*), and five species of Pines.

There are besides in the South Atlantic and Gulf States a number of trees which only grow in the vicinity of the ocean, and which have their relationship mostly with tropical trees, as, for instance, the Palmetto, the Red Bay (*Persea Caroliniensis*), the Mock Orange (*Prunus Caroliniana*), the Dahoon Holly (*Ilex Dahoon*), the Live Oak (*Quercus virens*), the Mangle (*Rhizophora Mangle*), and the Georgia Bark (*Pinkneya pubens*).

We have also to consider a few trees in the South Atlantic States which are restricted to very narrow limits, and which are probably to be regarded as survivors of an ancient vegetation in gradual process of extinction. These are the Florida Yew (*Taxus Floridana*), and the Florida Cypress (*Torreya taxifolia*), both occupying a narrow strip on the Apalachicola River in Northern Florida; Fraser's Balsam (*Abies Fraseri*), of the mountain peaks of North Carolina; the Southern Hemlock (*Tsuga Caroliniana*), confined to the Southern Alleghanies, and Chittim Wood (*Rhus cotinoides*), growing on the bluffs of the Tennessee

River in Northern Alabama, and again to a limited extent in Arkansas and Texas, to which we should perhaps add a species of Bay (*Gordonia pubescens*), which has not been observed in a wild state for many years and is perhaps already extinct, and a species of Alder (*Alnus maritima*), a small tree growing in Eastern Delaware and Maryland.

Two or three peculiar trees occur in the lower Mississippi Valley which can hardly be classed as belonging to any of the other regions; these are, first, the Osage Orange (*Maclura aurantiaca*), growing in Arkansas, the Indian Territory, Eastern Texas, and Louisiana; and, second, a species of Thorn (*Crataegus berberifolia*), which seems to be confined to portions of Florida and Mississippi.

The great State of Texas seems to unite to some extent the main forest divisions of the country, merging on the east into the Atlantic Region and on the west into that of the Rocky Mountains and Great Basin. In the eastern and southern portions of the State, however, there are a few trees which are either peculiar to the district or are northward extensions of East Mexican trees. Among them we may mention a species of Buckeye (*Ungnadia*), a species of Red-bud (*Cercis reniformis*), the Pistachia, two species of *Sophora*, the Texas Madrona (*Arbutus Texana*), an Iron-wood (*Bumelia cuneata*), the Mexican Persimmon (*Diospyros Texana*), the Thick-leaved Elm (*Ulmus crassifolia*), and a marked variety of Red Cedar.

Passing now to the west we enter the Interior Rocky Mountain Region. And this we find to be divisible into two sections: first, the flora of the mountains and interior basin; and, second, the flora of the arid plateau adjoining the Mexican border, and extending from Western Texas to Southern California. The first district embraces Utah and Nevada, the northern portions of New Mexico and Arizona, with Colorado, Wyoming, and parts of Montana.

The tree vegetation of this district is very limited, confined principally to the mountain ranges. The number of species is very few, principally the following: two species of Maple, one Locust (*Robinia Neo-Mexicana*), one Ash (*Fraxinus anomala*), one Oak (*Quercus undulata* var. *Gambellii*), three Poplars (*Populus angustifolia*, *P. tremuloides* and *P. balsamifera*), two or three varieties of *Juniperus;* about five species and varieties of Pine (*Pinus flexilis*, *P. ponderosa*, *P. edulis*, *P. monophylla*, and *P. Balfouriana* variety *aristata*); two species of Spruce (*Picea Engelmanni* and *P. pungens*); and one Balsam (*Abies subalpina*).

The southern part of this Interior Region, sometimes called the Texano-Mexican district, extends from Western Texas to Southern California.

The trees of this arid belt number about fifty species, a portion of them being confined to the region of the Lower Colorado, called the Colorado desert, and the remainder dispersed through the dry elevated plateaux, and on the mountains rising from the same, with their slopes and cañons. The more frequent of these trees are, two species of Mesquit and the

Screw-bean (*Prosopis*), several specimens of *Acacia* and *Lucæna*, two species of *Parkinsonia*, one Iron-wood (*Olneya*), one *Dalea*, one *Zizyphus*, the Giant Cactus (*Cereus giganteus*), one species of *Chilopsis*, one Sycamore (*Platanus Wrightii*), about five species of Oak, one Juniper or Arizona Cedar, one Cypress, four species of Pines, the Desert Palm (*Washingtonia filifera*), and two species of tree Yuccas.

We next arrive at the Pacific Region. This, like the other regions, presents a northern and a southern portion. The northern portion, including Washington Territory and Oregon, west of the Cascade Mountains, and also including the northern part of California, is heavily timbered with some of the largest and most magnificent Conifers of the world, such as the Douglas Spruce, the Western Arbor Vitæ (*Thuja gigantea*), the Nootka or Yellow Cedar (*Chamæcyparis Nutkäensis*), *Pinus monticola*, or White Pine, *Pinus Lambertiana*, or Sugar Pine, *Pinus ponderosa*, or Yellow Pine, Oregon Spruce (*Picea Sitchensis*); two species of Hemlock (*Tsuga Mertensiana* and *T. Pattoniana*); one Larch (*Larix occidentalis*), and four superb Balsams (*Abies grandis*, *A. amabilis*, *A. nobilis*, and *A. magnifica*).

The southern portion of the Pacific Region embraces the larger portion of California, and is a much drier district, the plains and Pacific slopes being thinly wooded, but the higher mountain ranges and foothills presenting a great diversity of Conifers, some of them attaining enormous proportions.

In the entire Pacific Region we find but about ninety species of trees, the principal of which are as follows: One species of Buckthorn, two or three species of *Ceanothus*, one Buckeye, three species of Maple, one Box Elder, one Crab Apple, two or three species of *Prunus*, one *Nuttallia*, one Mountain Mahogany (*Cercocarpus*), one Redbud (*Cercis*), two Wild Thorns (*Cratægus*), one Flowering Dogwood (*Cornus Nuttallii*), one Elder-tree (*Sambucus glauca*), one Madrona-tree (*Arbutus Menziesii*), one Manzanita (*Arctostaphylos*), two species of Ash, one Laurel (*Umbellularia*), one Sycamore, one Walnut, one Myrtle (*Myrica*); ten species of Oaks, one Chestnut, one small Birch, three Alders (*Alnus*), three Willows, four Poplars, one California Nutmeg-tree (*Torreya*), one Yew, (*Texas brevifolia*), three Red Cedars (*Juniperus*), seven other trees called Cedars belonging to the genera *Libocedrus*, *Thuja*, and *Cupressus*, the two *Sequoias*, seven species of Firs, five species of Hemlocks and Spruces, two Larches, and fourteen species of Pines.

All the trees of the Pacific Region, except a few Poplars and Willows, are different species from those of the Atlantic Region, quite a number of them indeed belonging to genera which are not else where represented in the United States.

A person accustomed to the varied tree flora of the Atlantic Region will here miss many of the familiar trees of that region. On the Pacific side there are no Magnolias, no Basswoods, no Holly, no Locust, no Sweetgum, no Sourgums, no Persimmons, no Catalpa, no Sassafras, no

Bay-tree, no Elms, no Mulberry, no Hickory, no Beech, no Hornbeam, and only one small Birch. All the Oaks, Pines, &c., are of species different from those of the East.

To recapitulate, we have in Southern Florida 60 peculiar species, in the Atlantic Region about 175 species, in the Interior Region about 70 species, and in the Pacific Region 90 species, making a total of nearly 400 species.

Passing now from this outline of tree distribution, let us briefly review some of the larger orders or families, and note their distribution and range.

The family which is represented by the greatest number of species and is most widely distributed over the country is that of the Oaks, of which we have about 37 species of tree size, besides several shrubby species. Of these 23 species belong to the Atlantic Region, 8 species to the Pacific Region, and 6 species to the Interior and Texano-Mexican districts.

The next largest genus is that of the Pines, of which we have 34 species, distributed as follows: In the Atlantic Region 13 species, in the Pacific Region 14 species, and in the Interior and Mexican border 7 species and several varieties. If we take into account all the Conifers, including the Pines, we find that we have 80 species, the largest portion of which occurs on the western side of the continent.

The next largest family will be that of the Willows and Poplars, of which we have 21 or 22 tree species, a portion of them extending quite across the continent, the others pretty evenly divided between the Atlantic and Pacific Regions.

Of Maples we have about 10 species, 6 of which belong to the Atlantic and four to the Pacific and Interior Regions.

The genus Prunus presents 11 or 12 species, 6 of which are Atlantic, 4 Pacific, and 2 belonging to the Interior Region. The genus Cratægus or Thorns is represented by 11 species, all but 3 of which are confined to the Atlantic Regions.

The Ash family (Fraxinus) gives us 10 species and 2 or 3 varieties, of which 6 species belong to the Atlantic, 2 to the Pacific, and 2 to the southwestern regions.

The genus Carya, embracing the Hickories, furnishes 8 species, all confined to the Atlantic side of the continent.

The remaining genera have a less number of species, very few of them containing more than 5.

ADDRESS OF MR. PHIPPS.

Mr. R. W. Phipps, delegate from the Province of Ontario, addressed the Congress substantially as follows:

Mr. President: In this address I shall endeavor to give some idea of our position in Ontario with respect to forestry, the amount of land yet remaining in forest, the manner in which Ontario has been and is

being cleared, and the steps which are now being taken by the Ontario Government to prevent the too rapid deforesting of the land.

A hundred years ago Ontario was a forest, a forest of the most valuable description. Many millions of its acres, now largely farming land, were covered with magnificent groves of pine trees, many of them nearly 200 feet in height, and nearly 7 feet through at the base, running up a hundred feet without a branch. Some of them were rendered useful, being converted into lumber when they grew near rivers, or where, perhaps, our first attempts at railways penetrated the forest. But the vast majority, rolled together in log-heaps, fed the flames in many a woodman's clearing.

As it was with the pine so it was with the other trees. Down before the ax went the wide-spreading forests of maple and beech, of hickory and bass-wood—to pass into smoke, to clear the way for the farmer's plow. It must be remembered that this only applies, so far as pine is concerned, to the older settlements, which, however, cleared a good deal of the country. But now, and for many years past, pine and much hard wood have formed a large part of our exports, and are taken much more care of. The right to cut the pine is sold to the lumberman, and the settler may cut it on his lot for use, but not to sell. But if the lumberman has not cut it, the settler may clear the land and burn the wood.

That it was necessary that land should be obtained for agriculture none will deny, but had the cost of the sacrifice then been known, surely much would have been spared. We had in Ontario one large region where much of the forest was heavy black walnut. In all Ontario to-day there is so little left of merchantable black walnut that we are importing that wood from your Indiana, where also, we are told, it is becoming scarce. Some settlers of the early time speak of the difficulty they had in clearing the ground of the walnut trees. They contrived, however, to burn them, and many a square league of land now grows wheat which once grew walnut. In later years they have had an opportunity of judging how profitable their work was when, for one or two of these giants left standing, they have received, as I am credibly informed, as much as a thousand dollars apiece. On many an acre there were fifty such trees, while it is very doubtful if any acre of them all has yielded for agricultural purposes a profit of a thousand dollars from that day to this. In Western Canada, winding through a district where now is scarcely a walnut tree, are two or three miles of an old corduroy road composed of this valuable and once abundant wood. Were its half decayed sticks but sound again they would be worth about a quarter of a million dollars.

The lesson we may learn from the manner in which land has been disposed of to the settler in Ontario, and the results which have followed, undoubtedly make it a question of very grave consideration whether in all future sales of Government lands, before any region is thrown

open for settlement, certain large portions, comprising probably not less than one-third of the whole, should not be reserved permanently as forest lands and preserved perpetually in good and reproductive condition by proper officials appointed by the Government, whose duty it should be to prevent injury, so far as possible, by fire, by cattle, or by unlawful appropriation of timber. It would then be in the power of those who lay out the tracts to leave permanently in timber a great proportion of the mountain, of the swamp, and of the rocky or inferior land, and to throw open for cultivation those portions best fitted for the plow. There is no doubt that such regulations would prove extremely beneficial to the territories settled, and that the cost of Government supervision would be far more than repaid by the sale of the overplus of the timber preserved.

By one means and another, we have been reduced in many parts of Ontario to 10 per cent. of timbered land. Other portions have 20 per cent. and some 40 per cent. left. But the quantity in these is being rapidly reduced. And it is found that through the absence of sheltering forests the winter winds are much more keen than formerly, rendering the keeping and care of cattle much more expensive, while by blowing the protecting snow from the fields, great injury is done to the important crops of winter wheat and clover.

In addition to the grave evils which threaten Ontario, should its stock of firewood be largely destroyed, our supply of wood for many important manufacturing purposes is beginning to run low. Our furniture manufacturers have no more walnut; they find white-ash difficult to obtain; bass-wood, of which we formerly possessed vast amounts, is now so diminished in quantity that the swamp-elm has to be substituted. Our agricultural-implement makers and car-builders, too, already find good oak ash, and rock-elm so hard to obtain that where they can they use iron instead, and in many other woods the present deficiency, as compared with the former abundance, is extremely marked.

If matters were likely to continue in their present position, that is to say, become no worse, there would not be so much occasion for alarm. But this is not to be expected. The railways, the farm-implement makers, the furniture men, the house-builders, the wagon-makers, and the workers in many other industries, are rapidly consuming our stores of wood, and, above all, the farmer in the back townships continues, with ax and torch, to pursue the work of destruction.

It has been proposed in Ontario, as being probably the only way to secure the continuance of any sufficient portion of the interspersing forest, to permit the farmer to obtain on application an exemption from local taxation on such part of his forest as he might declare his intention of continuing in woodland, and from which he will agree to exclude cattle and to cut none but grown timber (15 inches at the base being probably the smallest allowable in most varieties), the exemption to continue while the forest is so preserved. If, however, the owner should

wish at any time to cut down the trees on the reserved portion, or use the ground for pasture, it is suggested that he then become liable for the taxes which have been remitted to him or the bonus allowed.

The Ontario Government have lately passed an act for the encouragement of tree-planting which it is expected will be of great benefit, and which provides that farmers planting trees along the roads or along the dividing lines of farms, some yards apart, will, if the trees are in good order in three years' time, receive 25 cents per tree from the township councils, half of which the Ontario Government will repay to the councils. Many thousand trees have already been planted under this law.

It is plain that the first thing in order to stimulate the community to proper action is to furnish it with the data necessary to produce opinion. Acting upon this idea, Government distributed last year throughout Ontario fifteen thousand copies of a forestry report, which some of you may have seen, which will be followed shortly by another, containing much practical knowledge and experience on the subject. The various counties are to be communicated with in regard to the reservation and protection of portions of forests now in private hands, and means will shortly be taken to investigate the question of the best methods of preservation from fire and continuance in reproductive condition of some of the principal pine forests in the interior.

There is no doubt whatever in the minds of those who have studied this subject, even within the narrow limits which Ontario affords, that the interspersion of a proper amount of forest, though apparently abstracting from the cultivable area of the country, really abstracts nothing, but, on the contrary, adds much. The farmer has found by repeated experience that when the forest is cleared the soil no longer yields its original return. If every farmer would retain, or would plant upon his land, a fair proportion of forest, the benefits to himself and to the country at large would be very great. It is in all such cases our experience in Ontario that cultivation is easier and more profitable, that stock need less food and less shelter, and that winter life in general, and traveling in particular, are far more comfortable than when the country has been reduced to a bare expanse of snowy surface.

Much has been said concerning the influence of forest on rainfall, and it has been admitted by all that, whether forests occasion rain or not, they undoubtedly act as reservoirs of moisture. We know that the clearing of forests dries the land, that surface-creeks by the thousand cease altogether to flow. We know that over vast districts, where wells of 10 feet had been of ample depth, wells of 20, 30, and 40 feet are needed when the forest goes. The retaining of a due proportion of forest greatly aids in giving rain to the fields when rain is most necessary to render them fertile.

I have spoken of the personal interest of the farmer, or other landholder, in forestry. But, passing from the personal to the national view, our populations, pouring from the Old World to the New, or drawing their

first breath upon our shores, have a duty to perform in the matter which cannot be gainsaid. We received America as a land rich in forest, in stream, in fertile soil fit for the future support of countless multitudes. We know what ruin the deprivation of forests has brought upon other lands. We can, in vast floods here, in failing fertility there, already see the premonitions of that ruin in our own. Let us remember that we must not destroy the power of the land to support those who are to come after us. Along the path we tread they will shortly follow. Let us endeavor to stay the tendency to render that path barren and desolate, and strive to leave it as we found it, blossoming with life and fertility, a remembrance to our successors that in our day we endeavored to perform our duty to the land which supported us—a remembrance than which, had we the choice of the wealth of the universe, we could leave them nothing more valuable.